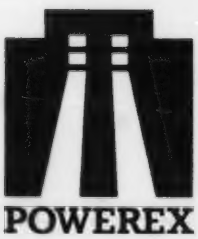
OPERATIONAL REVIEW
FOR
OPERATING YEAR

OCTOBER 1989 TO SEPTEMBER 1990



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1.0 POWEREX

1.1 GOALS AND OBJECTIVES

The British Columbia Power Export Corporation (POWEREX), a wholly-owned subsidiary of BChydro, was established in December 1988 by the British Columbia Provincial government to be the single window agency responsible for implementing the Provincial policy of international electricity trade. It's charter is to conduct long term firm electricity trade utilizing private sector financing, operating capabilities, and generating resources.

2.0 POWEREX HIGHLIGHTS

POWEREX was featured in a profile on BChydro which appeared in the September 1990 issue of the industry and trade publication "Electrical Equipment News". In the article the Provincial export policy as formulated by B.C.'s Provincial Minister of Energy, Mines and Petroleum Resources, the Honourable Jack Davis was presented. The article described the government's interest in endorsing private sector development of electricity projects through the POWEREX single agency window. This development would result in increased potential for employment opportunities for B.C. residents, added value to resources, financial benefits to British Columbians, and development of resources which could later be used to meet domestic electricity needs. In the article President and CEO of POWEREX, Ken Epp, described the POWEREX mission as the support of British Columbia's economic growth through the facilitation of environmentally sound private sector electricity trade development. The POWEREX Power Pool objectives and operating plans, which include the buying, selling, storing, lending, exchanging and wheeling of electricity were also discussed.

2.1 WORKSHOPS

A POWEREX Power Pool (PPO) Workshop was held on 9 July 1990. The purpose of the presentation was to introduce the PPO concept and initiate feedback on the development of an appropriate pricing structure and efficient operation procedures. This conference attracted over one hundred ten attendees representing US and Canadian utilities, Independent Power Producers, and bulk customers.

2.2 POWEREX CONTRACTS

In August 1989 POWEREX entered into an energy storage agreement with Alcan. This agreement permitted Alcan to store into BChydro reservoirs beginning 1 May 1990 through to 31 August 1990, on a "last in - first spill" basis. After 1 Sept 1990, and upon agreement with Alcan, POWEREX could purchase Alcan's storage energy and re-sell it in spot market.

POWEREX has also negotiated "Prime the Pump" (PTP) Contracts with the following utilities and agencies: Pacific Gas & Electric, for a 200 MW (megawatts) supply from 1 July 1990 to 30 Sept 1990, later extended to November; California Department of Water Resources (CDWR), for a 75 MW supply in August 1990, and a 200 MW supply from September through November 1990; and Sacramento Municipal Utility District (SMUD), for firm capacity from 100 to 200 MW, and energy from 1 Jan 1991, for from one to five years. Bonneville Power Administration (BPA), which agreed to provide access for POWEREX, has an option with POWEREX to purchase amounts equal to the PTP contracts.

2.3 LICENCE APPROVALS

An application for modification of the current, jointly held, Energy Removal Certificates (ERCs) was submitted by BChydro and POWEREX to the Provincial Ministry of Energy, Mines and Petroleum Resources (MEMPR). Approval for modification of the ERCs was granted in September 1990, extending the term of the current ERCs through to 31 September 1991.

A request for a one year extension to the current export licences, and amendment to include POWEREX as joint holder of the export licences was submitted to the National Energy Board (NEB) by BChydro. On 27 September 1990 the Federal Government granted approval (Order in Council P.C. 1990-2090) to BChydro and POWEREX for one year extensions of the current export licences through to 31 September 1991.

The CDWR contract received NEB approval in August 1990.

2.4 REQUEST FOR PROPOSALS

POWEREX Vice-President and Director of Market Development, Doug Forrest attended a Los Angeles Department of Water Power (LADWP) informational meeting on 12 July 1990 in regard to generation and transmission. One proposal was submitted 4 Sept 1990 on behalf of the PowerAlliance Corporation. The LADWP short-list of Requests For Proposals (RFP) is expected by 18 December 1990.

SMUD and POWEREX met on 24 October 1990 to discuss four IPP proposals submitted to the RFP issued in May 1990. SMUD requested POWEREX assistance in short-listing the four proposals.

2.5 POWEREX INITIATIVES

In late July 1990 POWEREX presented Washington Water Power (WWP), Puget Sound Power & Light (PSP&L), and Montana Power Company (MPC) with proposals for future long-term sales utilizing proposed interties.

In early October 1990 Puget Sound Power & Light reviewed the four POWEREX short-listed IPP proposals for a contract with delivery to commence in 1993/94.

2.6 NEGOTIATIONS

In August 1990 BChydro, POWEREX, and TransAlta Utilities Corporation (TAUC) carried on negotiations on a coordination agreement.

Near the end of June 1990, Montana Power Company and POWEREX met to discuss a potential long-term energy (150 average MW) and capacity (200 MW) sales agreement utilizing the Washington Water Power Intertie.

In mid-August 1990 the Utah Associated Municipal Power System (UAMP) approached POWEREX requesting a short-term firm contract for 30 MW over a one year term from January through December 1991 .

In late August POWEREX and Washington Water Power discussions resulted in an offer to WWP for capacity sales supply of 150 MW from December 1990 to February 1991. WWP and POWEREX also held discussions on an Intertie, with Bonneville Power Administration (BPA) involvement, on 23 July 1990 and 5 Sept 1990.

Near the end of August 1990 PSPL had obtained a Memorandum of Understanding with BPA for an intertie with BChydro.

3.0 POWEREX POOL OPERATION

3.1 GOALS AND OBJECTIVES

The POWEREX Pool Operation (PPO), which is part of POWEREX, is the marketing exchange operation that will serve the short term (transactions with a duration of less than one year) bulk electricity markets inside, and outside the Province of British Columbia. The objectives of the PPO are: to maximize the return on the use of BChydro facilities and expertise for short-term electricity transactions; offer electricity suppliers and bulk purchasers greater access to bulk electricity markets; and enhance the value and usability of electricity surpluses produced by small independent suppliers.

3.2 MEMBERSHIP

Various Canadian and US investor owned companies, utilities, and agencies have expressed interest in PPO membership.

3.3 SUMMARY FOR OPERATING YEAR OCTOBER 1989 THROUGH SEPTEMBER 1990

3.3.1 REVENUE SUMMARY

Net revenues from interchange, *shown on Chart 1*, were approximately $56 million ($Can) greater than the amounts which were forecast last year. Actual energy exports were about 1800 GWh more than those used in the October 1989 export revenue forecast. The accumulated gross export, plus other transactions revenue, was about $71 million more than forecast due to higher sales volumes and prices obtained. The amount of sales was limited by various factors described in the 3.3.3 Sales Summary.

3.3.2 PACIFIC INTERTIE LOADING

The intertie access to the Pacific Southwest (PSW) markets was generally good throughout 1989/90. Good access was a result of the occurrence of below average U.S. Columbia River streamflows, increased intertie capacity, and other conditions as explained below.

3.3.3 SALES SUMMARY DETAILS

In October and November 1989, the export market price range fluctuated between the low 20 mills (a mill is $0.001Can) per kilowatt-hour and the high 20 mills range. Due to low BChydro system reservoir storage levels, sales were restricted to the SMUD (Prime the Pump) contract which was offset by purchases from TAUC. In mid-October, however, an earthquake in California caused damage to generation facilities in that area. POWEREX was able to offer emergency assistance to PG&E, which initially helped PG&E. At the end of October a renewable block sale was also made to PG&E, at 29 mills, as there still were

Chart 1

various generating unit problems due to the earthquake damage, and one of PG&E's nuclear electrical generating units went out of service. Block sales were continued to PG&E through January. *Chart 2 indicates the energy Sales (Exports) which occurred during the 1989/90 Operating Year.*

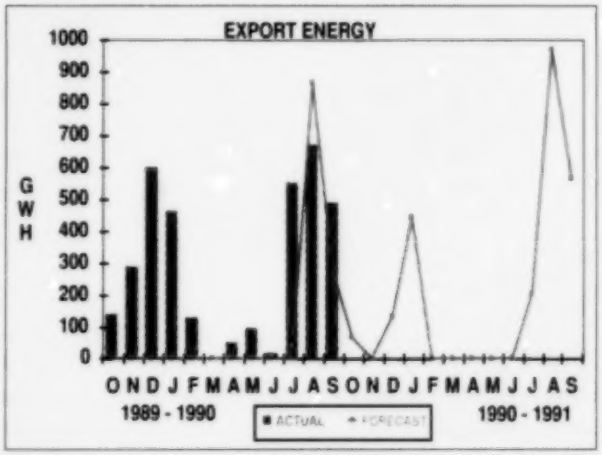

Chart 2

In January, block sales to PG&E, Portland General Electric (PGE), LADWP and WAPA accounted for 90% of total sales. A cold spell in February, however, created a very strong export sales market; prices ranged from 30 to 32 mills. *Chart 3 indicates the monthly average Export (Sell) energy price.* Sales from storage, however, were restricted to helping utilities in dire need, not for economic displacement. Due to the low storage levels of BChydro reservoirs during this time, sales were supported by electricity purchases from Alcan and TAUC, and gas purchases from B.C. Gas for operation of the Burrard Thermal generating plant.

Through March and April, BPA non-firm and surplus-firm sales dominated the spot export market. The Pacific North-South Intertie was in Condition 1 or 2, which blocked POWEREX access to the South-West markets. By mid April, however, there was a decrease in the BPA snowmelt runoff forecast, which led BPA to increase their prices, and allowed POWEREX to sell a small amount to PGE.

Continued cool weather delayed the Columbia Basin Runoff which forced BPA to ease off on sales for the first two weeks in May. POWEREX was then able to sell 100 GWh at an average price of 22 mills. When the snowmelt runoff increased at the end of May, POWEREX was again shut out of the export market. This poor market for POWEREX energy continued through June, although POWEREX was able to sell to the South-West over certain hours when BPA was unable to deliver. POWEREX was, at times, able to sell some energy to the Pacific North-West at prices slightly below Bonneville Power's non-firm price.

On July 10, the market on the N-S Intertie opened up to POWEREX for peak demand hours deliveries. Shortly thereafter the Intertie was open to POWEREX for all hours, as a result of decreasing Columbia River streamflows. The decreasing streamflows, caused by a hot weather spell,

Chart 3

reduced the US Pacific North-West supply to the point where supply could no longer keep up with increasing South-West demand.
During July and August, POWEREX adjusted

prices, mainly in the Light Load Hours, to maximize sales and to keep BChydro's Mica (MCA) and Revelstoke (REV) electrical generators running at maximum. This mode of operation was to prevent the Mica reservoir (Kinbasket Lake) from overfilling and subsequently spilling. BChydro

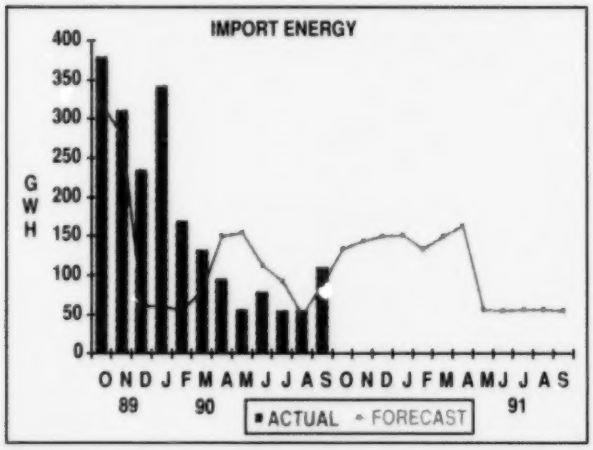

Chart 4

forecasts had indicated a high probability of spill at Mica. The July electricity sales prices ranged from 15 to 24 mills.

In mid-August, a cool spell of weather in California (drop of 15-20 degrees F), and improved performance of Pacific North-West and South-West Thermal and Nuclear units, led to a poorer than expected market for POWEREX. Forest fires and storms in the middle of August also affected the US Pacific North-South AC intertie, and many utilities were forced to cut schedules to protect the the coordinated system operation. The potential spill at Mica and an excellent power supply outlook in the US Pacific North-West, due to improved Columbia River basin streamflows, also combined to produce lower prices: August prices ranged from 12 to 28 mills.

This trend of low prices continued into the first part of September; however, forced outages both in Los Angeles and the Pacific North-West led to increased demand for spot market energy. POWEREX was able to meet the export demand because BChydro was able to utilize the Non-Treaty Storage Agreement water stored in Mica and Arrow reservoirs. During this time, a Monroe Transformer outage in the BPA system restricted intertie transfers from Ingledow to Custer. Prices in September began at 19 mills for Light Load Hours, 23 mills for Heavy Load Hours, and closed the month at 25 mills for Light Load Hours, 28 mills for Heavy Load Hours .

3.3.4 SUMMARY OF PURCHASE

Energy purchases, *as indicated on Chart 4*, were about 600 GWh more than forecast, at an accumulated purchase cost of about $10 million more than forecast. The majority of these additional purchas-

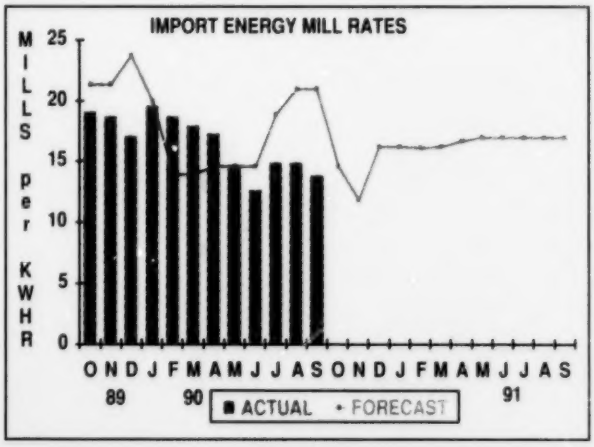

Chart 5

es were made to back up sales commitments. *Chart 5 indicates the average monthly Import (Buy) price.*

4.0 BCHYDRO RESOURCES

4.1 HYDRO GENERATION

4.1.1 RESERVOIR OPERATIONS

The BChydro Integrated System total reservoir energy content at the end of the 1989/90 Operating Year was approximately 760 GWh greater than the BChydro probable projection which was made on 1 October 1989. The higher than average annual inflows in the Peace River and Columbia River basins accounted for the majority of the increase in system storage energy content.

4.1.2 COLUMBIA RIVER SYSTEM

The 1990 total Columbia River basin runoff for the Operating Year 1989/90, as measured at the lower Columbia River Dalles stream gauge, was 92% of average. The portion of the Columbia River basin above Keenlyside was 104.9% of average. The Pacific Northwest reservoirs were refilled to 99.1% of full energy storage content on 31 July 1990 in spite of the January to June runoff which was only 92% (99.7MAF) of normal. This was the fourth consecutive year when runoff has been below normal at the Dalles. *Chart 6 indicates the changes that occurred in the monthly forecasts and the final recorded inflow, for the January through July forecast period.*

Mica Reservoir is operated for BChydro requirements, within the guidelines prescribed by the Columbia River Treaty. The reservoir operation is also affected by BChydro operations under the Non-Treaty Storage Agreement between BChydro and BPA. This agreement allows for additional storage of water, and release of that water, from the Mica and Arrow Reservoirs, and the shared use of BChydro and U.S. generation along the Columbia River. The Non-Treaty Storage Agreement in effect during the 1989/90 Operating Year accounted for 2.0 MAF of storage at Mica, and can fluctuate Mica reservoir level by approximately 20 feet.

Mica reservoir began the BChydro 1989/90 Operating Year (October to September) with both

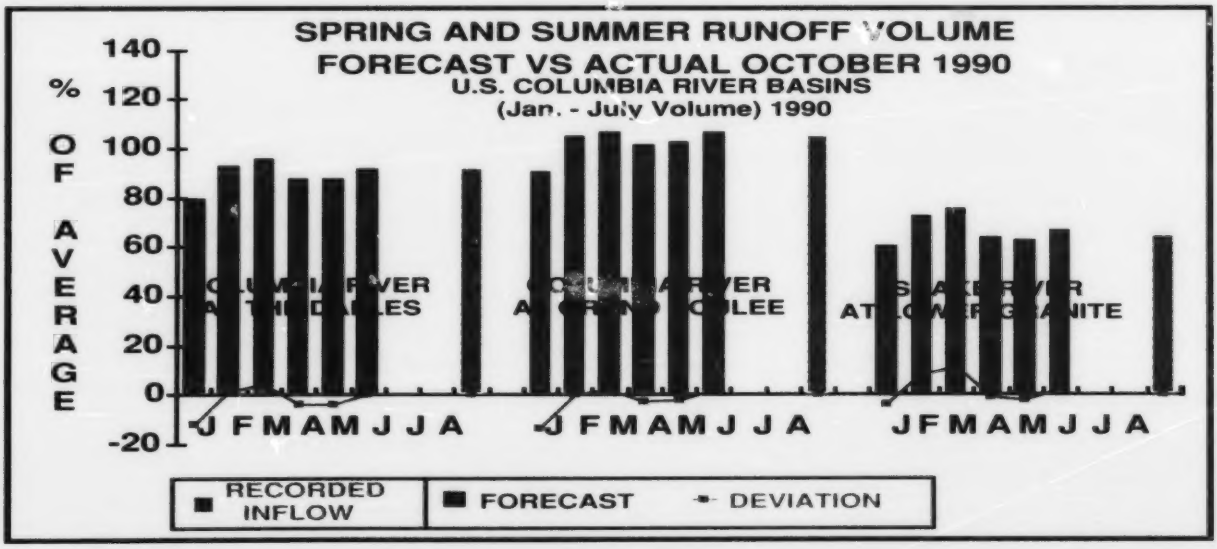

Chart 6

the BChydro and BPA Non-Treaty Storage spaces near empty, and the Treaty storage space full. The Mica Treaty storage was only 70% full at the end of the Columbia River System Operating Year, 31 July 1989, but continued to fill through August and September, and was entirely refilled by 17 September 1989. Due to high runoff forecast for the spring freshet, Mica Reservoir had been drawn down to 2389.6 feet by 17 April 1990. All treaty projects were refilled by the summer, and both BChydro and BPA refilled their Non-Treaty Storage Agreement spaces in Mica Reservoir.

Transfers of water between Mica and Arrow reservoir, which resulted in different Mica water releases from the amounts required by the Columbia River Treaty, were made by BChydro to improve BChydro system operating flexibility. These transfers were consistent with the Treaty, and maintained Treaty flow (water release) requirements at the British Columbia border. BChydro operates all Treaty projects to provide weekly Columbia River flows at the British Columbia border as agreed between BChydro, BPA and the US Army Corps of Engineers (COE), consistent with the Columbia River Treaty Detailed Operating Plan (DOP) guidelines.

4.1.3 STREAMFLOW CONDITIONS

The recorded BChydro Integrated System reservoirs February to September snowmelt runoff was 103.6% of average. The snowpack varied from well above average in the Peace River basin, above GMS plant, to well below average in the Vancouver Island and Lower Mainland regions. Heavy rainfall in late May produced a record peak daily inflow to Williston Lake (storage reservoir for GMS plant). Summer and fall precipitation was well below average for all projects except in the Upper Columbia basin. *Chart 7 illustrates how the monthly BChydro Snowmelt Runoff Forecasts varied for the major river systems*

GMS ACCUMULATED PRECIPITATION

Cumulative precipitation above GMS, *as shown on Chart 12 (page 15)*, was above average with very heavy rains in late May and early June. The summer and fall rainfall was below average.

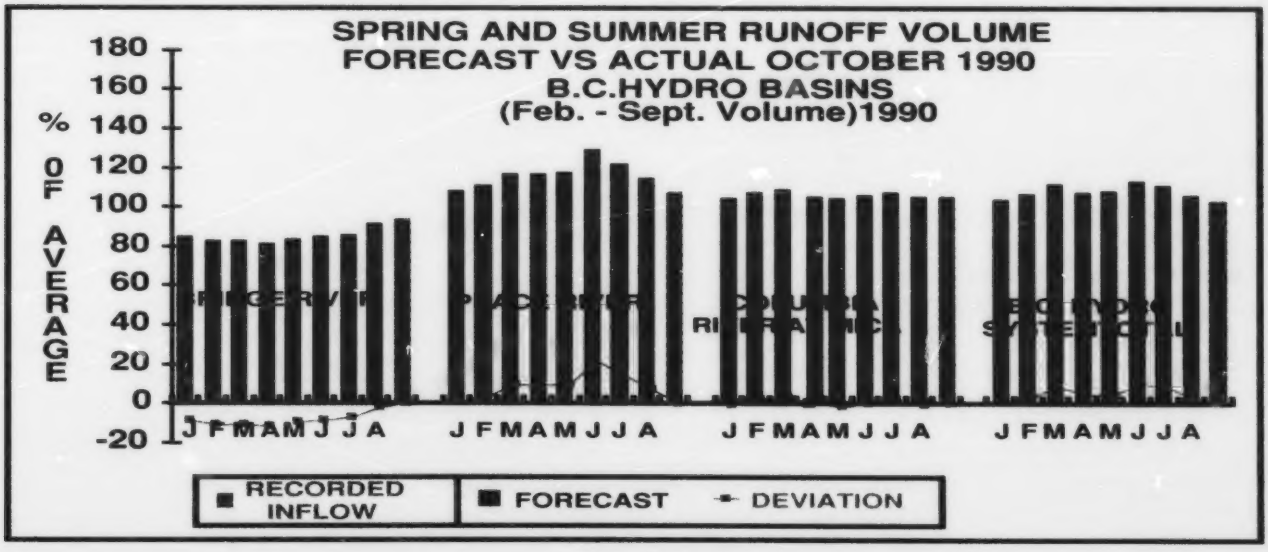

Chart 7

MICA ACCUMULATED PRECIPITATION

Cumulative precipitation upstream from Mica, *as shown on Chart 9 (page 11)*, was above average, mostly due to heavy snowfall in November. Subsequent precipitation was near normal.

4.1.4 IMMEDIATE SPILL IMPORTS

On occasion, BPA needs to generate more energy during the light load hours, because of limited hydro storage flexibility, than their electricity demands plus exports can use. To assist BPA in this situation, BChydro accepts electricity imports from BPA, "for immediate spill". The 1990 immediate spill imports from BPA began on 5 June and ended on 17 June. At the conclusion of the transactions on 17 June, a total of 67,470 MWh of energy had been imported from BPA. Five BChydro plants, namely ASH, CMS, SON, PUN, and KCL, were designated and reduced generation to allow the import of the energy from BPA. Water equivalent to the amount of energy imported was then spilled at the five designated plants .

4.1.5 SPILL AT BCHYDRO PROJECTS

From 1 September 1989 to 31 October 1990, BChydro spilled a total volume of water having the potential to generate approximately 1064 GWh of electrical energy. Of that potential energy, only 80 GWh (7.5%) could actually have been utilized for generation with the installed plant capacity available. Seventy percent of that usable 80 GWh was spilled due to a combination of the following:

Trash-rack failure at Stave Falls;
required Dam Safety spills at Jordan River;
forced outages at Seven Mile, Wahleach, and Revelstoke; and
leakage through the Alouette adit gate.

The remaining thirty percent of the usable water was spilled due to unfavourable inflow distribution, and other plant restrictions.

4.2 THERMAL GENERATION

4.2.1 SUMMARY

This is the second year since 1980 that Burrard Thermal Generating Station (BUT) units were run for BChydro Integrated System energy support. The output during the 1989/90 operating year, *as shown on Chart 8*, totaled 1587 GWh. During the previous operating year, 1988/89, BUT generated 3355 GWh.

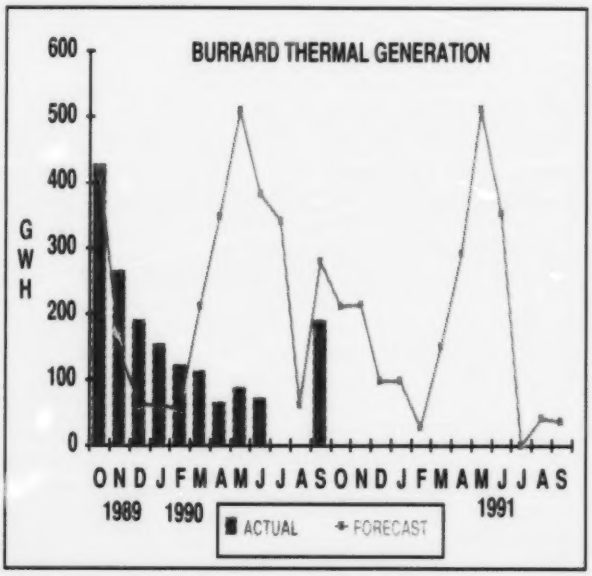

Chart 8

4.2.2 FUEL SUPPLY

Firm Gas was purchased from Mobil for the November 1989 to October 1990 period in order to operate two BUT units at minimum operating levels. This operation was required to provide additional voltage support in the Lower Mainland portion of the BChydro Integrated System.
Swing Gas was also purchased from B.C. Gas during the November 1989 through March 1990 period to enable additional BUT energy generation.

This generation was supplemental to the energy produced from the Firm Gas generated for BChydro Integrated System energy support.

4.2.3 BCHYDRO INTEGRATED SYSTEM REQUIREMENTS

When the BChydro 1 April 1990 Snowmelt Volume Runoff Forecasts became available, there was a strong indication that the expected runoff volume, for the February to September period, would be much above average. Since this meant that there was some probability of system spill, BUT operation was limited to utilization of the contracted Firm Gas only for the April to June period. During July and August BUT was actually shutdown to maximize the output of the Mica (MCA) and Revelstoke (REV) hydro generating plants, since these plants had a high probability of spill. With BUT shutdown the expenditure on gas purchases was minimized.

Mica and Revelstoke subsequently did not spill, and in September, after the risk of spill was past, BUT units were again brought on line to provide BChydro Integrated System energy support by utilizing the Firm Gas and seasonal (Valley) gas.

4.3 THE 3CS

4.3.1 CONSERVATION

Demand Side Management, better known as BChydro's POWER SMART program, was calculated to have reduced the 1989/90 BChydro energy demand by approximately 90 GWh. This was somewhat less than the forecast reduction of 182 GWh. However, load reductions due to the POWER SMART program have tripled over the past year, and are expected to continue growing rapidly over the next few years.

4.3.2 COORDINATION

In the 1989-90 Operating Year BChydro operated additional storage space in the Mica reservoir under a coordination agreement with BPA. This agreement, the Non-Treaty Storage Agreement (NTSA), signed and implemented in 1984, enabled BChydro and BPA to jointly share use of: 2.0 MAF of storage space at Mica; the Mica and Revelstoke generation facilities; and all the US generating facilities on the mainstem of the Columbia River downstream of BChydro's Keenleyside project. The NTSA has provided significant benefits to BChydro since 1984. This year BChydro and BPA were again able to conserve water that would have otherwise been spilled and save (store) it for generation later.

4.3.3 COGENERATION

Cogeneration energy supplied to the BChydro Integrated System from industrial plant generation sources was limited to approximately 15.5 GWh, primarily from Evans Products, and West Coast Energy.

4.4 INDEPENDENT POWER PRODUCERS

In November 1989 POWEREX announced its shortlist of five Independent Power Producers (IPP) projects resulting from its Call For Expressions of Interest (EOI) in early 1989. The five projects, which had a combined capacity of 930 MW, were: TransAlta Resources/Alberta Natural Gas - Crowsnest Cogeneration; Westar/Shawinigan Integ - East Kootenay Thermal; Selkirk Power Partnership - Selkirk Power Project; Long Lake Energy - BC Interior Woodwaste; and Energy America - Southern BC Power Project.

The announcement of the short list was coincident with the announcement by the BC Energy Minister on the Provincial government policy on long term exports. The policy stated that development of generation projects for export would occur primarily in the private sector (IPP's) with POWEREX providing supporting services and market access via BChydro staff and the BChydro Integrated System.

During the 1989-90 Operating Year POWEREX has provided the IPP's with market intelligence information based on assessments undertaken by POWEREX. This has resulted in POWEREX and the IPP's submitting several proposals to prospective purchasers in the US. Specifically, POWEREX submitted proposals for four of the five short list projects to SMUD in response to SMUD's RFP in March 1990. POWEREX also submitted a proposal for one of the projects (Southern BC Power Project) in response to LADWP's RFP in June 1990. Four proposals were also submitted to PSPL in September 1990. All of these proposals involved development of new generation resources by the IPP with POWEREX providing wheeling, shaping, and capacity backup services to support the IPP generation. In the case of the proposals to SMUD and LADWP, POWEREX also undertook to take the lead in negotiating wheeling agreements with BPA to obtain market access.

POWEREX has also provided general information to a number of other US utilities, including MPC and WWP.

5.0 BCHYDRO INTEGRATED SYSTEM MAINTENANCE AND RELIABILITY

5.1 SIGNIFICANT EVENTS

Both 500 kV circuits between the Revelstoke Generating Plant and the Ashton Creek Substation were lost, from June 12 to 18, due to mudslides. The loss caused spill to occur at Revelstoke equivalent to approximately 49,000 MWh of energy, valued at nearly one million dollars. Export capability was also curtailed during this period due to the loss of generation from the Revelstoke plant

Bonneville Power's Monroe Substation 500/230 kV transformer outage for bushing replacement, from September 15 to October 8, reduced the transfer capability of the BChydro-BPA 500 kV intertie to 1250 MW, from its normal rating of 2000 MW. This, in turn, reduced the ability of POWEREX to market energy to the Pacific Northwest and Southwest.

At Bonneville Power's Custer substation one of the two 500/230 kV transformers was destroyed by fire on August 30 1990. During the transformer outage the normal Import limit of 2000 MW, for electricity transfers from BPA to BChydro, was reduced to 1500 MW. A replacement transformer bank is expected in service January 1991.

5.2 RELIABILITY

BChydro replaced multicone insulators on the High Voltage Direct Current (HVDC) System to improve equipment reliability.

The Nicola - Ingledow 500 kV circuit towers that had iced-up badly in February 1990, and resulted in several trip outs, had "Ice-links" installed . The Ice-links are expected to improve the security of this circuit.

500kV/230 kV circuit breaker modifications were carried out, and are on going, to improve BChydro electrical system reliability.

"Voltage derived" power sources were added to

the 500 kV series capacitors at the Kennedy capacitor station. This is expected to reduce breaker operations and improve the reliability of the station.

The American Creek capacitor stations were added to increase the energy transfer capability from the Southern Interior Region to the Lower Mainland portion of the BChydro electrical system.

5.3 SPECIAL OPERATIONS

During the Monroe transformer outage, coincident with the Nelway Boundary tie out of service for phase shifter installation, extra export capability was made available by connecting a Kootenay Canal generator to the WKPL system.

5.4 COLUMBIA RIVER SYSTEM

5.4.1 MICA RESERVOIR REGULATION DURING THE 1990 FRESHET

Mica Reservoir, located in the head water of the Columbia River, is a major storage reservoir constructed for both flood control and power generation. Like other reservoirs in the interior of British Columbia, Mica receives a fresh supply of inflow from the annual snow melt. Higher than average snowmelt runoff was forecast for Mica Reservoir this year. *Chart 9 indicates the monthly and cumulative precipitation into the Mica reservoir basin.* The forecast runoff, which was 105.3% of average in January, increased to 108.4% in February, and to 109.4% by 1 March. The high runoff forecast, plus the essential seven month outage to Mica generator number 4 (G4), for runner seal repairs, exerted tremendous decision pressure on BChydro's Operations staff. "Should an outage be undertaken, to ensure that Mica G4 would be reliable for winter peaking, in a year forecast to have an above average runoff ?"

BChydro's Maintenance Engineers estimated costs in the order of $250,000 to reduce the seven month outage to a five month outage. This was a substantial sum, but it only represented about one unit-day of generation from the possible spilled water.

The decision was made to proceed with the repair of Mica G4 to ensure that it could provide reliable service over the 1990/91 winter, in spite of the high snow melt forecast and the small window of time available for such a complex repair. The unit was taken out of service on 20 February with the understanding that acceleration of the repair program was essential.

A continuous review was made of the need for overtime to carry out the work versus the risk of

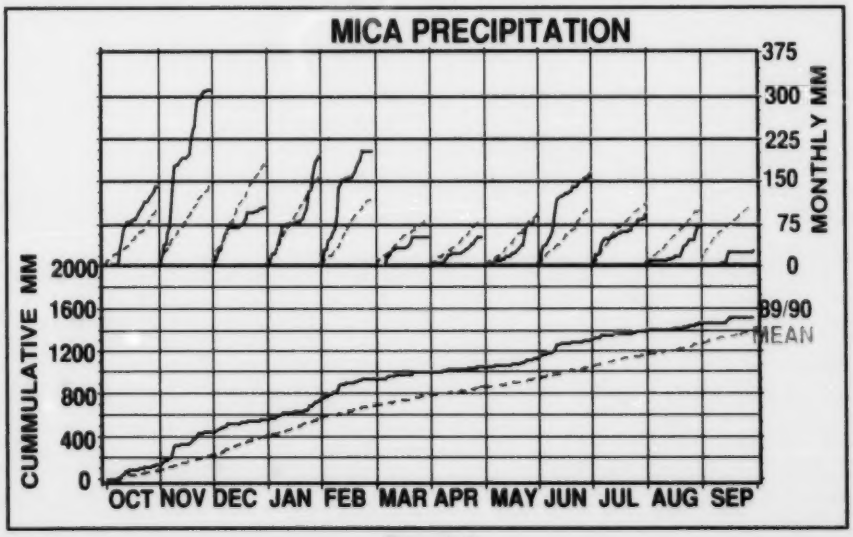

Chart 9

spill at Mica. The review considered historic inflow distributions, combined with constraints such as the Columbia River Treaty requirements, and other generator outage requirements. Each review confirmed that the Mica G4 outage should be completed by July to minimize the risk of spill. The findings were discussed with the Production field staff and a co-coordinated Mica G4 repair schedule, making optimal use of overtime, was developed to complete the work and return the unit to service while minimizing the risk (and amount) of spill.

The exceptional high temperatures in early July melted the snow at an accelerated rate raising the reservoir elevation by one foot per day, even with all the available Mica turbines in full operation. At that time, the potential for spill was very high, and appeared inevitable. Mica G4 was returned to full load service on 27 July; five and one quarter months from the 20 February when it had been taken out of service. Procedures to draft the Revelstoke forebay to receive any possible Mica spill, and to surcharge Mica Reservoir should the snowmelt runoff be 108.4% of average as forecast, were prepared.

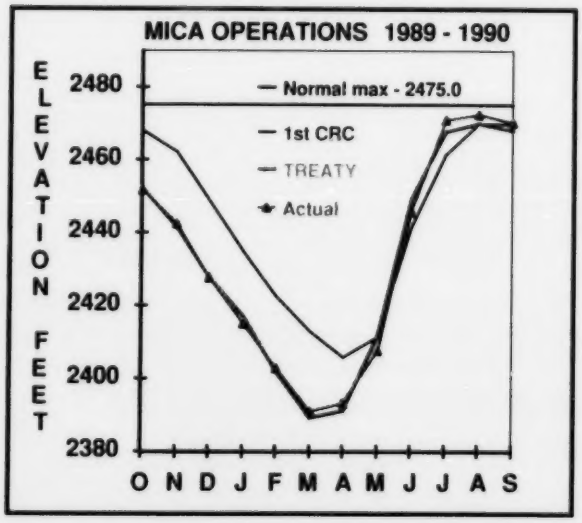

Chart 10

By early August, the cooler temperatures, diminished snow pack, speedy return of Mica G4 to service, and a stronger export market for POWEREX combined to reduce the probability of spill at Mica. The Mica reservoir continued to fill at a reduced rate of 0.14 feet per day during the first three weeks of August, and reached a peak elevation of 2474.08 feet on 23 August 1990, just 0.92 feet below full reservoir level. The last few inches of reservoir filling was due to a rainstorm in the basin. With the inflow reduced by half, the Mica plant operation was revised to run at maximum efficiency.

The calculated risk had paid off, despite the complexity of the Mica G4 repair, the high snowmelt runoff, and other system conditions, including the loss of both Revelstoke to ACK transmission lines (June 12-18), which had severely curtailed releases from both the Mica and Revelstoke plants. BChydro crews and staff had repaired Mica G4 in record time, improved system reliability and regulated Mica Reservoir to within the top foot without any spill at Mica.

If Mica G4 had not returned to service on 27 July, the reservoir level would have reached elevation 2475.0 feet by 11 August, and spilled 225,780 cfsd of water by 23 August. The spilled water would have had the potential to generate 241,584 MWh of energy, at an estimated value of $4.83 million at the current energy rates of 20 mills/kWh.

Had G4 returned to service 5 days later than 27 July, the reservoir would have peaked at 2475.0 (full pool) instead of 2474.08 feet. *Chart 10 indicates the Mica Reservoir elevations for the 1989/90 Operating Year.*

5.4.2 REVELSTOKE

When the two 500 kV transmission lines from Revelstoke were forced out of service because several towers were washed out by mudslides, Revelstoke generators were limited to serving the smaller local electrical demand. Efforts were made to minimize turbine releases from Mica into Revelstoke reservoir. These efforts included recalling to service other BChydro generating units which were on maintenance outages, and requesting energy imports from BPA. In spite of these efforts, approximately $980,000 worth of energy was spilled past Revelstoke. The Revelstoke forebay was surcharged by 1.74 feet above its normal maximum elevation of 1880 meters, prior to return of the first transmission line to service, preventing additional spill worth an estimated $381,000.

BIG EDDY FLOODING

In the last ten years, some local residents living in the Big Eddy area of Revelstoke have experienced basement flooding when Arrow reservoir is near full pool (1444 feet). This past summer at least two residents experienced basement flooding when Arrow reservoir was surcharged to 1446.0 feet. To minimize the severity and duration of the flooding, BChydro increased the release of both Mica Active storage and Arrow Recallable storage from Arrow Dam to lower the water level in Arrow reservoir. Action was also taken to reduce the Revelstoke discharge into Arrow. Other means of resolving the flooding problem are currently under investigation.

5.4.3 ARROW (KEENLEYSIDE PROJECT)

The Keenleyside Project navigation lock was damaged and forced out of service on 19 February. To assist log loading at the mill downstream from the project, special hourly flow adjustments were made. The lock was subsequently taken out of service for repairs, from April 13 through 22, again requiring special operations, and restrictions, to the project flows to assist downstream mill operations.

Several severe dust storms were experienced around the Arrow reservoir during May and June, due to wind movement of exposed silt along the drawdown zone. This problem is under active study by BChydro to find a satisfactory, and hopefully permanent solution to this problem.

5.5 PEND OREILLE RIVER SYSTEM

SEVEN MILE SPILLWAY

In July 1990 the Seven Mile spillway was tested for high releases at the maximum reservoir level. The tests were required to evaluate automatic spill procedures, as part of the Seven Mile dam safety program. Co-ordination was required with: BChydro staff concerned with scheduling, implementing tests, and monitoring the spillway, tailrace, and reservoir during tests; as well as the U.S. Corps of Engineers, West Kootenay Power, BPA, and the B.C. Water Comptroller's office.

5.6 PEACE RIVER SYSTEM:

5.6.1 PEACE RIVER ICE FORMATION

The period of annual ice formation, and retreat on the Peace River extended from 4 November 1989 to 11 April 1990. During this time, BChydro and Alberta Environment shared the task of monitoring the advance, and later the retreat, of the ice front. BChydro maintained controlled high discharges from Peace Canyon plant for a short period in November, which countered the advancing ice front, and for most of the period from 20 December to mid-February, when the ice front began to retreat.

Flows were constantly monitored and regulated to avoid flooding during the advance, and recession, of the ice front. *Chart 11 indicates the Peace River ice front locations during the 1989-90 Operating Year.*

5.6.2 RECORD BREAKING INFLOWS

Over the 1 June to 13 June 1990 period the Peace River experienced record breaking inflows. The daily average inflow into Williston Lake on 1 June 1990 was 383,000 cfs (10,850 m^3/sec). This inflow was 102% of the previously recorded peak daily inflow which occurred on May 1972 in the period after the completion in 1968 of the WAC Bennett Dam. It was 144% of the previously recorded peak in the period from 1917 to 1968, prior to the construction of the WAC Bennett Dam.

The Peace River near Taylor B.C. had a record peak flow of 159,000 cfs (4,500 m^3/s) on 2 June. This was 79% of the historical peak observed in 1972, after the Peace River flows became regulated by the dam. It was 39% of the highest flow recorded in May 1948, prior to completion of the dam. There has only been one other year since 1968 when the river flow was higher at this location than recently observed.

The time required for water to travel from the Peace Canyon project (PCN) to Taylor is approximately one day. Using this time delay, the flow experienced at Taylor, and the Town of Peace River, Alberta, would have been higher by 365,400 cfs (10,350 m^3/s), if regulation of flows by the WAC Bennett Dam had not reduced the Peace River flows. Unregulated flows at Taylor would then have been 524,200 cfs (14,850 m^3/s). That would have been 139% of the highest flow recorded by that gauge since 1914.

The time required for water to travel from PCN to the Town of Peace River in Alberta is approximately two days. Using this time delay, the flow that the Town of Peace River would have experienced on 3 June would have been 598,350 cfs (16,950 m^3/s). Several days later, on the 13 June,

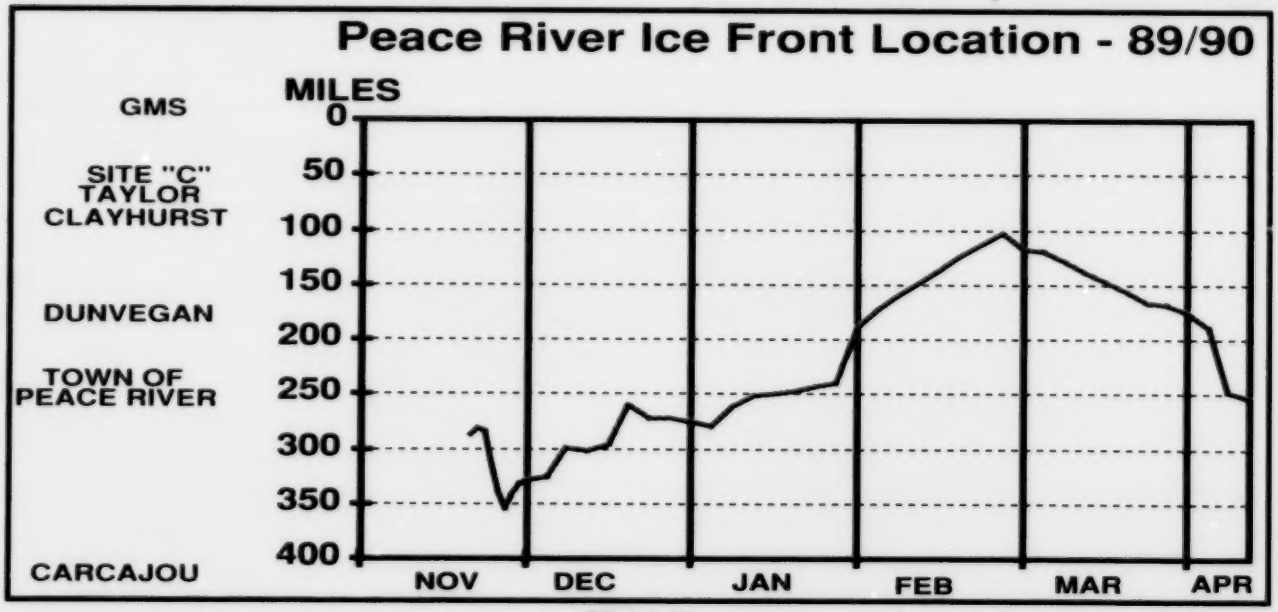

Chart 11

flows of 681,300 cfs (19,300 m^3/s) were recorded at the Town of Peace River. Without the regulation provided by the WAC Bennett Dam (on 11 June), flows would have been approximately 857,800 cfs (24,300 m^3/s), or 176,500 cfs (5,000 m^3/s) higher than those recorded.

The rainstorm which was centered near the Williston Lake drainage basin at the end of May, improved BCHydro's energy supply by approximately 2,000 GWh. *Chart 12 indicates the precipitation experienced in the Williston basin over the 1989/90 Operating Year. Chart 13 (page 16) illustrates the improvement in the total BChydro system reservoir storage due to the better than average inflows experienced during the year.* This improvement could have a positive impact of from $30 to $50 Million if POWEREX is able to market this energy before the reservoir reaches maximum reservoir level and spills.

The rain event in early June, which was centered in the Thompson Okanogan area, did not improve the BChydro energy picture on either the Columbia River or the Peace River. It did, as previously noted, severely impact BChydro operations by reducing the energy transmission capability from Revelstoke with the loss of the two 500kV transmission lines from Revelstoke. In order to reduce the generation at Mica, minimize the spill at Revelstoke (which was carrying only local load), and meet electrical system demand, BChydro had to increase the generation at GMS and PCN.

The second rainstorm which hit the Dawson Creek, Grand Prairie Region in early June, and created the record Peace River flows at the Town of Peace River on 13 June, had peaked at 45.6 feet (at about 08:00 PM), with only 1.5 feet of freeboard remaining at some dike locations in the Town..

BCHydro was in constant contact with the Alberta Government Environment staff in regard to the flood forecast for the Peace River. BChydro maintained contact with Alberta Environment staff after the river levels had dropped over 16 feet (5 m), since some portions of the water saturated dikes had sloughed into the river. The effective freeboard in these areas had been reduced to about 3.25 feet (1 m). BChydro continued to be in close contact with Alberta Environment until the flood threat had eased, and repairs to the dike were completed.

BCHydro also monitored river levels in the Lower Fraser River, in the event that the B.C. Provincial Water Management Branch in Victoria could have

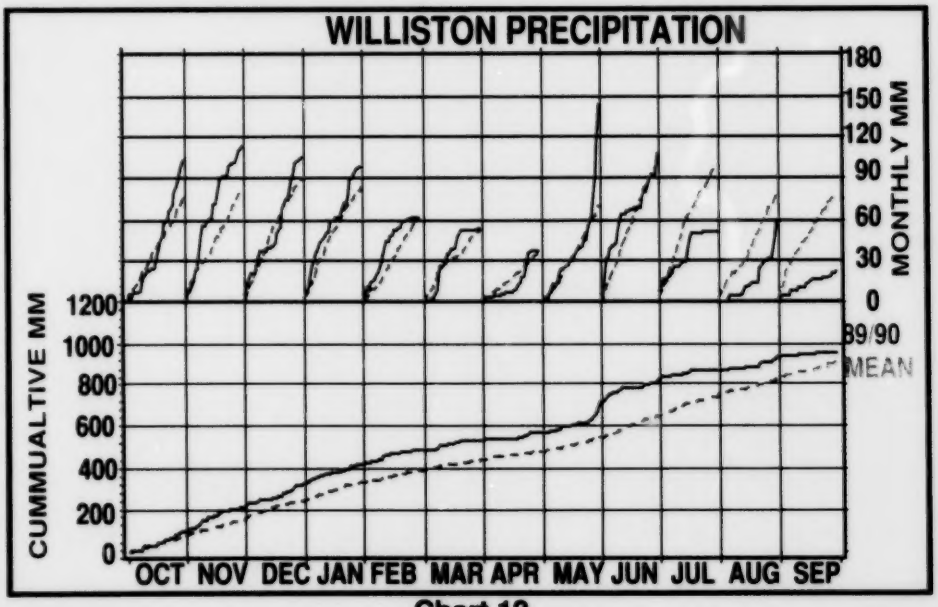

Chart 12

required BChydro to reduce the flows from Bridge River projects, or the Stave River Projects.

5.6.3 PEACE R. BRIDGE CONSTRUCTION

BChydro cooperated with Alberta efforts to construct a bridge across the Peace River, 20 miles downstream of the Town of Peace River (TPR). In addition to daily transmittal of hourly flows along the Peace River, BChydro coordinated Integrated System generation to minimize the periods when Peace Canyon discharge was greater than 55,000 cfs, equivalent to plant generation of 550 MW. This was done to prevent combined PCN flows and high local runoff from producing flows that could have overtopped the cofferdams at the bridge construction site.

5.6.4 G.M.SHRUM MAJOR OVERHAUL

G.M. Shrum unit number four was taken out of service for a major overhaul on 4 April 1990. To increase the likelihood of the unit returning in a timely fashion to meet high winter domestic loads and POWEREX export commitments, additional work hours were initiated. The additional hours were projected to increase anticipated repair costs by $20,000, and enable the unit to return to service by 4 November 1990.

RESTRICTED USE OF WAHLEACH PLANT

The Wahleach (WAH) reservoir was drafted lower than normal in preparation for a WAH generator stator rewind in the Spring 1990. The rewind was subsequently postponed due to deficiencies in the new winding. Until the unit is rewound, it must operate with a derated maximum capacity of 58 MVA, whereas the normal unit capacity is 75 MVA.

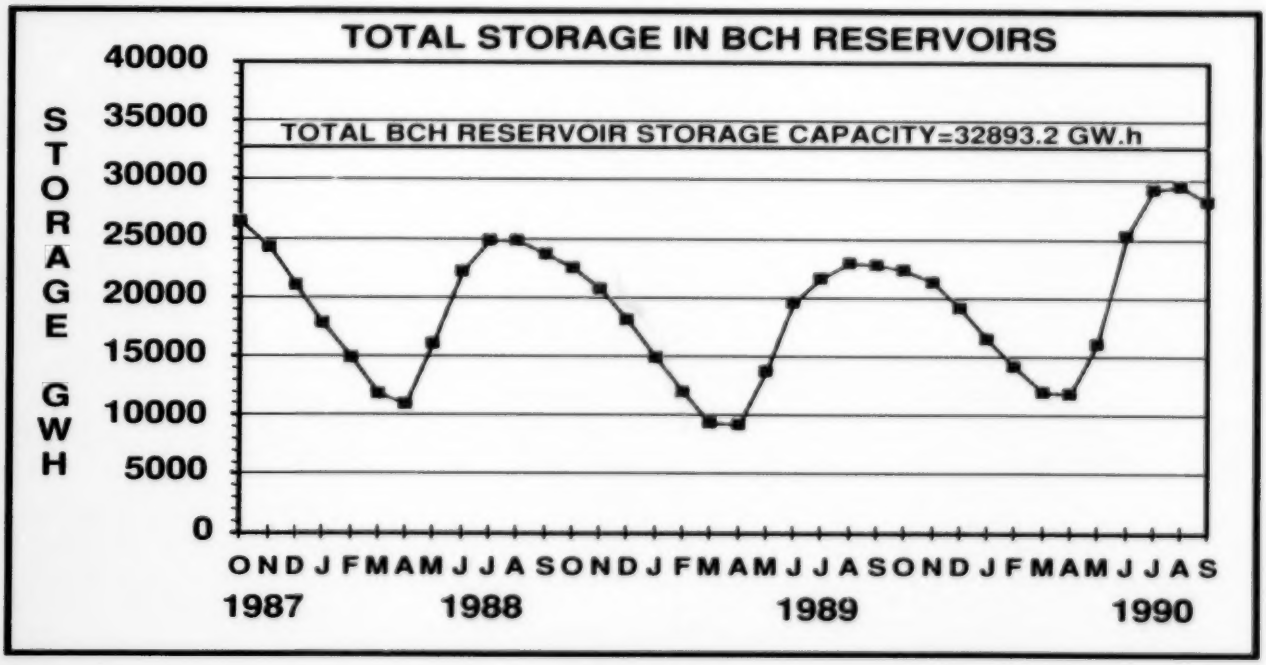

Chart 13

WAH RESTRICTIONS DUE TO FRASER RIVER FLOWS

The high Fraser River flows this past year raised the water level at the outlet of the Wahleach powerhouse to the point where it affected the unit's ability to pass full turbine flow. Frequent monitoring of the Fraser River water level was necessary to ensure that the unit output matched that permitted by the Fraser River water level. Maximum power release during this period was essential to reduce the risk of spill once the reservoir reached full pool.

WAHLEACH SPILLWAY RESTRICTIONS

Dam safety investigations revealed that the Wahleach spillway might not withstand a high release without some damage to the spillway channel. To reduce the risk of damage due to high spills, the reservoir was regulated below its normal maximum operating elevation from 16 feet (5m) to 23 feet (7 m) during the spring and summer period.

6.0 OPERATIONAL PLANNING OUTLOOK

6.1 ENERGY PLANNING ASSUMPTIONS

The following basic assumptions were used in the October 1990 Average and Critical Water Energy studies and the Marginal Cost (MC) studies for the1990/91 Operating Year:

STREAMFLOWS

Average Water and Marginal Cost (MC) studies.
Average water conditions, represented by the historical period of record 1940 through 1985, are used until the BChydro Snowmelt Volume Runoff Forecast inflows, based on current snowpack and 1973-88 weather sequences, are available. Snowmelt forecasts are normally available from January through August. Studies are carried out monthly using updated system data.

Critical Water Studies
The Critical Water study uses the 1942-43 historical water year, until the BChydro Snowmelt Volume Runoff Forecast inflows are available. The snowmelt forecasts for critical water studies are based on current snowpack and the most adverse weather sequence for the Peace and Columbia basins. All other projects continue to use the 1942-43 inflows, inclusive. Four year Critical Period Sequence studies, using inflows from the historical period of record 1942-46, are carried out monthly.

ELECTRICAL DEMAND (LOADS)

The BChydro Load Forecast, dated 26 September 1989, from Load Forecast Department was used. Energy Studies for December 1990 to September 1991 will use an updated BChydro load forecast.

MARKETS

Imports Available
ALCAN: committed of 670 GWh, and uncommitted of 573 GWh.
Alberta: committed of 148 GWh, and uncommitted of 947 GWh.

Exports

U.S.: committed of 775 GWh, uncommitted (discretionary) market of 5700 GWh .

BURRARD THERMAL PLANT

Swing gas contract: potential energy equivalent of 641 GWh (332 GWh committed, 309 GWh discretionary).
Discretionary seasonal gas: potential energy equivalent of 3430 GWh.
Other discretionary gas: potential energy equivalent of 1449 GWh.

COLUMBIA RIVER PROJECTS

The Non-Treaty Storage Agreement (NTSA) operations are expected to utilize some of the additional 2.5 MAF of Mica storage designated under new NTSA agreement during Operating Year 1990-91. The NTSA storage is expected to be drafted over the winter period and refilled during the April through August period.

6.2 1990/91 OPERATING YEAR

6.2.1 LOAD AND RESOURCE FORECAST

The energy studies indicated that there is energy available for export when all available resources (including imports) are considered, under either Average or Critical water conditions during the 1990-91 Operating Year. *Chart 14 indicates the electrical demands and resources used to meet those demands for the respective Average and Critical Water scenarios, including estimates of the 3C's, Conservation, Coordination, and Co-generation.*

If greater than Average water conditions were to occur there would be a reduced requirement for

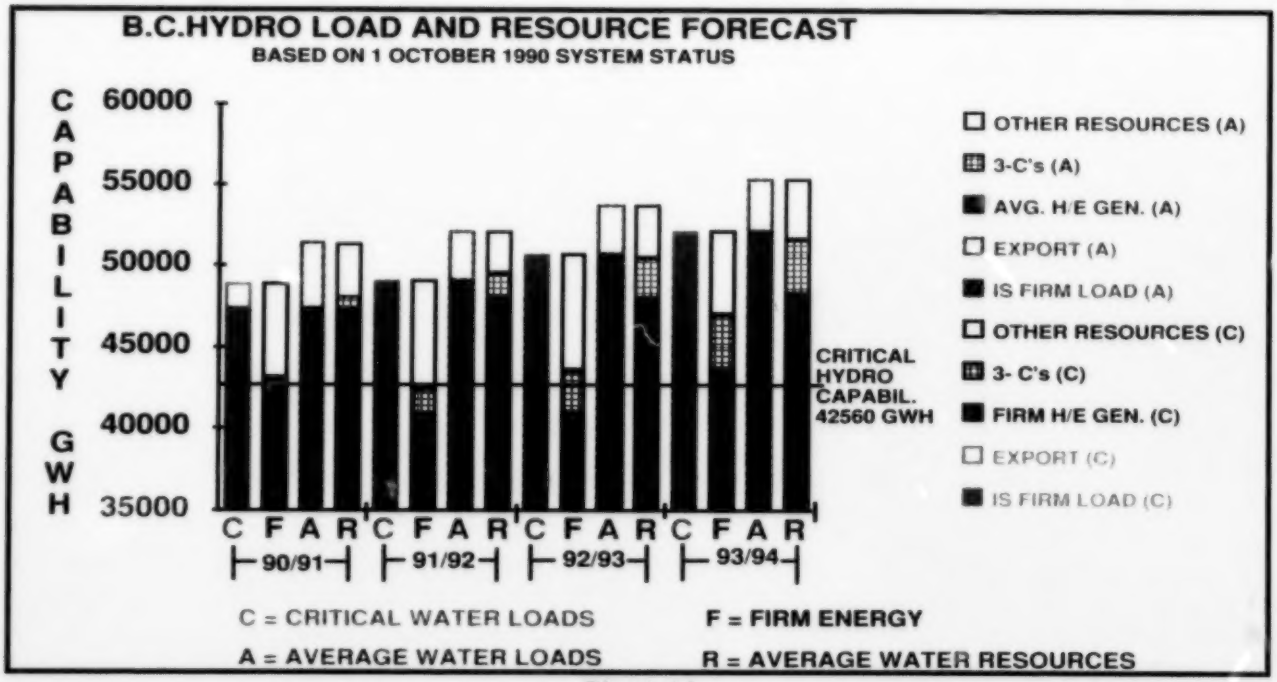

Chart 14

Burrard generation and purchases to restore Williston reservoir levels. Under Average water conditions the system is capable of supplying exports of approximately 3160 GWh, and restoring Williston reservoir levels, by generating 2019 GWh from Burrard using seasonal gas, and by purchasing 1312 GWh from Canadian sources. Under these Average water conditions the Williston reservoir would draft to elevation 2157.7 feet by 30 April 1991, and recover to elevation 2191.5 feet by 30 September 1991.

Uncommitted energy exports are not included in the Critical Water study, and almost all of the seasonal and swing gas available for Burrard (3911 GWh), as well as 1897 GWh of imports, are used to maintain Williston reservoir levels. Under Critical Water conditions Williston reservoir would be drafted to elevation 2153.8 feet by 30 April 1991, and refilled to elevation 2185.7 feet by 30 September 1991.

Energy studies indicate that there is no surplus hydro energy available for export under Average or Critical water conditions. With Average inflow conditions, total exports of 3160 GWh are assumed to be met by using Burrard Thermal generation on valley gas, and energy purchases (imports).

6.2.2 MARGINAL COST

Based on the operational planning assumptions used, the BChydro Integrated System short term marginal cost is expected to increase by about 1 mill/kWh through the end of September 1991. *Chart 15 shows the average monthly Export (Sell) Price from Chart 3, and the average monthly Import (Buy) Price from Chart 5, for Operating Year 1989/90, and indicates the expected short term Buy-Sell range for operating Year 1990/91.*